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Productivity Growth and Capacity Utilization in Canadian Business Industries

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.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E}	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

Productivity Growth and Capacity Utilization in Canadian Business Industries

by Wulong Gu and Weimin Wang

This article in the *Economic Insights* series reports the impact of correcting for variations in capacity utilization on multifactor productivity growth in Canadian business industries. It is based on a recently released Statistics Canada research paper. Results show that multifactor productivity growth is procyclical for almost all business industries, largely reflecting variations in capacity utilization in some industries, especially in manufacturing and mining. After correcting multifactor productivity growth rates for pro-cyclicality, the slowdown in multifactor productivity post-2000 is significantly reduced.

Measures of multifactor productivity (MFP) growth are often used to track movements in technical progress and production efficiency. They do so by comparing actual growth rates in output with the expected increase in output from an increase in inputs using pre-existing or current production techniques.

Official statistics for MFP growth in Canada and other countries, as well as those compiled by international statistical agencies, are estimated residually as actual output growth net of the contributions of growth of all inputs. The result is that measured MFP growth is pro-cyclical, i.e., rising in economic expansions and falling in economic downturns.

Understanding sources of the pro-cyclicality of measured MFP growth has important theoretical and empirical implications in economic and policy studies. The literature provides three major explanations for measured MFP growth being pro-cyclical: shocks to production technology are a major driving force of business cycles; output growth outpaces input growth during economic expansions due to increasing returns to scale; and capacity utilization rates rise when an economy expands.

Among the three explanations, variations in capacity utilization have little to do with technical progress: however, they introduce a cyclical bias into measured MFP growth. It is therefore important to correct for capacity utilization variations in the measurement of MFP growth. For instance, Canada has recently undergone substantial changes associated with a resource boom and an upward appreciation of the Canada–U.S. exchange rate. Baldwin et al. (2011) use microdata to study plant adjustments arising from adjustments in export markets, and the resulting declines in capacity utilization, to show that the fall in standard measures of MFP growth during this period results primarily, if not completely, from the decline in capacity utilization. Post-2000 changes in the economy then require re-examination and evaluation of the standard non-parametric estimates of MFP growth and how they can be modified to take into account structural change.

Numerous studies since Solow (1957) have tried to adjust the MFP growth measure for capacity utilization, but the adjusted MFP growth measures remain pro-cyclical. This is the result of the use of ad hoc proxies for capacity utilization that lack adequate theoretical frameworks.[1]

A recently released Statistics Canada research paper (Gu and Wang 2013) revisits the issue, by developing a theoretical framework for a non-parametric approach that appropriately adjusts MFP growth for variations in capacity utilization over time. In this paper, capacity utilization of capital is defined as the ratio of capital-in-use to the capacity level of capital (capital-in-place). Capital-in-use is calculated as the optimal level of capital input required to produce the level of output observed.

Is capacity-utilization-adjusted productivity still procyclical?

Based on the economic concept of capacity utilization of capital, Gu and Wang (2013) provide alternative estimates of MFP growth for Canadian business industries, and compare them

1. See Gu and Wang (2013) for a detailed discussion.

Table 1
Correlation between MFP growth and output[1] growth, 1961 to 2007

	Correlation coefficient	
	standard	alternative
Total business sector	**0.73**	**0.20**
Agriculture	0.96	0.46
Mining	0.79	0.03
Utilities	0.64	0.19
Construction	0.47	0.31
Manufacturing	0.85	-0.12
Wholesale trade	0.80	0.31
Retail trade	0.82	0.58
Transportation	0.79	0.62
Information	0.63	0.72
Finance, insurance and real estate	0.57	0.21
Professional	0.42	0.58
Administration	0.22	0.14
Education	0.62	0.61
Health	0.72	0.59
Arts, entertainment	0.60	0.52
Accommodation, food	0.26	0.31
Other services	0.53	0.43

1. Output is real value-added based

Source: Statistics Canada, authors' compilation based on KLEMS database

with the standard estimates. The correlation of growth in GDP or industry value-added and the MFP measures are presented in Table 1.

As expected, the standard measure of MFP growth is highly correlated with output growth for the business sector as a whole and in most business industries. After adjusting for variations in capacity utilization, the correlation coefficient between the alternative experimental measure of MFP growth and output growth drops from 0.73 to 0.20 for the business sector as a whole: this suggests that the pro-cyclicality of productivity in the business sector mainly reflects cyclical bias induced by mismeasurement of capital input.

The story varies across industries. For example, after the adjustment, MFP growth and output growth are no longer correlated in the mining and manufacturing industries. Also, the correlation coefficient is reduced significantly in agriculture, utilities, wholesale trade, and finance, insurance and real estate. In all other industries, the pro-cyclicality of productivity has little to do with variations in capacity utilization.

Do variations in capacity utilization matter for the post-2000 decline in multifactor productivity growth in Canadian business industries?

To answer this question, both the standard and alternative measures of MFP growth were estimated (on a real value-added basis) for Canadian business industries (Table 2). The standard measure of MFP growth declined considerably after 2000; a large portion of the decline reflected a decline in capacity utilization. Specifically, the standard measure of MFP growth averaged 0.3% per year before 2000 and -0.4% per year after 2000, for a drop of 0.7 percentage points in MFP growth between the two periods. After correcting for variations in capacity utilization, the drop in MFP growth was reduced considerably to 0.2 percentage points.

At the industry level, the drop in the annual average MFP growth appeared in agriculture, mining, construction, manufacturing, transportation, and health services (Table 2). Among these six industries, the only significant declines in capacity utilization were in mining, (-22%), and manufacturing, (-18%), over the 2000-to-2007 period (Table 3). In these two industries, the decline in capacity utilization accounted for a large portion of their post-2000 slowdown in MFP growth. After correcting for variations in capacity utilization, the drop in the annual average of MFP growth after 2000 decreased from 6.3 percentage points to 2.7 percentage points in mining, and from 2.1 percentage points to 0.6 percentage points in manufacturing.

Conclusion

Procyclical MFP growth in many Canadian business industries reflects variations in capacity utilization, especially in mining and manufacturing. As a result, the post-2000 decline in MFP growth in both mining and manufacturing was largely the result of the decline in capacity utilization in that period.

Table 2
Annual average of multifactor productivity growth[1]

	1981-2000		2000-2007		(2000-2007) - (1981-2000)	
	Standard	Alternative	Standard	Alternative	Standard	Alternative
	percent				percentage point	
Total business sector	**0.33**	**0.22**	**-0.37**	**0.02**	**-0.70**	**-0.21**
Agriculture	2.21	2.42	1.55	1.39	-0.66	-1.03
Mining	0.61	0.29	-5.73	-2.38	-6.34	-2.67
Utilities	0.89	0.49	1.30	1.54	0.41	1.05
Construction	-0.34	-0.10	-0.68	-1.54	-0.33	-1.44
Manufacturing	1.86	1.55	-0.28	0.94	-2.14	-0.61
Wholesale trade	2.21	2.37	2.28	1.80	0.06	-0.58
Retail trade	1.20	1.16	1.50	1.38	0.30	0.22
Transportation	0.64	0.59	-0.46	-0.54	-1.10	-1.13
Information	0.20	0.65	2.58	0.82	2.38	0.17
FIRE	-0.46	-0.38	0.32	0.15	0.78	0.53
Professional	-2.14	-2.06	-0.13	-0.72	2.01	1.34
Administration	-0.89	-0.83	-0.37	-0.43	0.53	0.40
Education	-0.66	-0.63	2.34	2.06	3.01	2.68
Health	-1.79	-1.41	-2.62	-2.27	-0.84	-0.86
Arts, entertainment	-3.21	-3.46	-1.20	-1.22	2.01	2.23
Accommodation, food	-1.30	-1.35	0.57	0.78	1.87	2.13
Other services	-1.84	-1.78	0.47	0.15	2.31	1.92

1. Output is real value-added based.

Note: FIRE stands for finance, insurance and real estate.

Source: Statistics Canada, authors' compilation based on KLEMS database.

Table 3
The 2007-over-2000 ratio of capacity utilization

	2007/2000
Total business sector	**0.94**
Agriculture	1.04
Mining	0.78
Utilities	0.98
Construction	1.33
Manufacturing	0.82
Wholesale trade	1.12
Retail trade	1.06
Transportation	1.02
Information	1.29
FIRE	1.02
Professional	1.26
Administration	1.03
Education	1.30
Health	0.94
Arts, entertainment	1.02
Accommodation, food	0.94
Other services	1.13

Note: FIRE stands for finance, insurance and real estate.

Source: Statistics Canada, authors' compilation based on KLEMS database.

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